



# Armed Forces College of Medicine AFCM



## **Viral Lower Respiratory tract infections (Part 1)**

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## INTENDED LEARNING OBJECTIVES (ILO)



**By the end of this lecture the student will be able to:**

1. Describe the structure and antigenicity of viruses causing LRTIs
2. Describe pathogenesis and clinical manifestations of viral LRTIs
3. Outline laboratory diagnosis of viral LRTIs.

# Respiratory Tract Infections

## Upper respiratory tract Diseases

### **Common Cold** **Pharyngitis**

Otitis Media

Sinusitis

### **Laryngitis**

Epiglottitis

## Upper and Lower respiratory Tract Diseases

### **Croup**

### **Influenza**

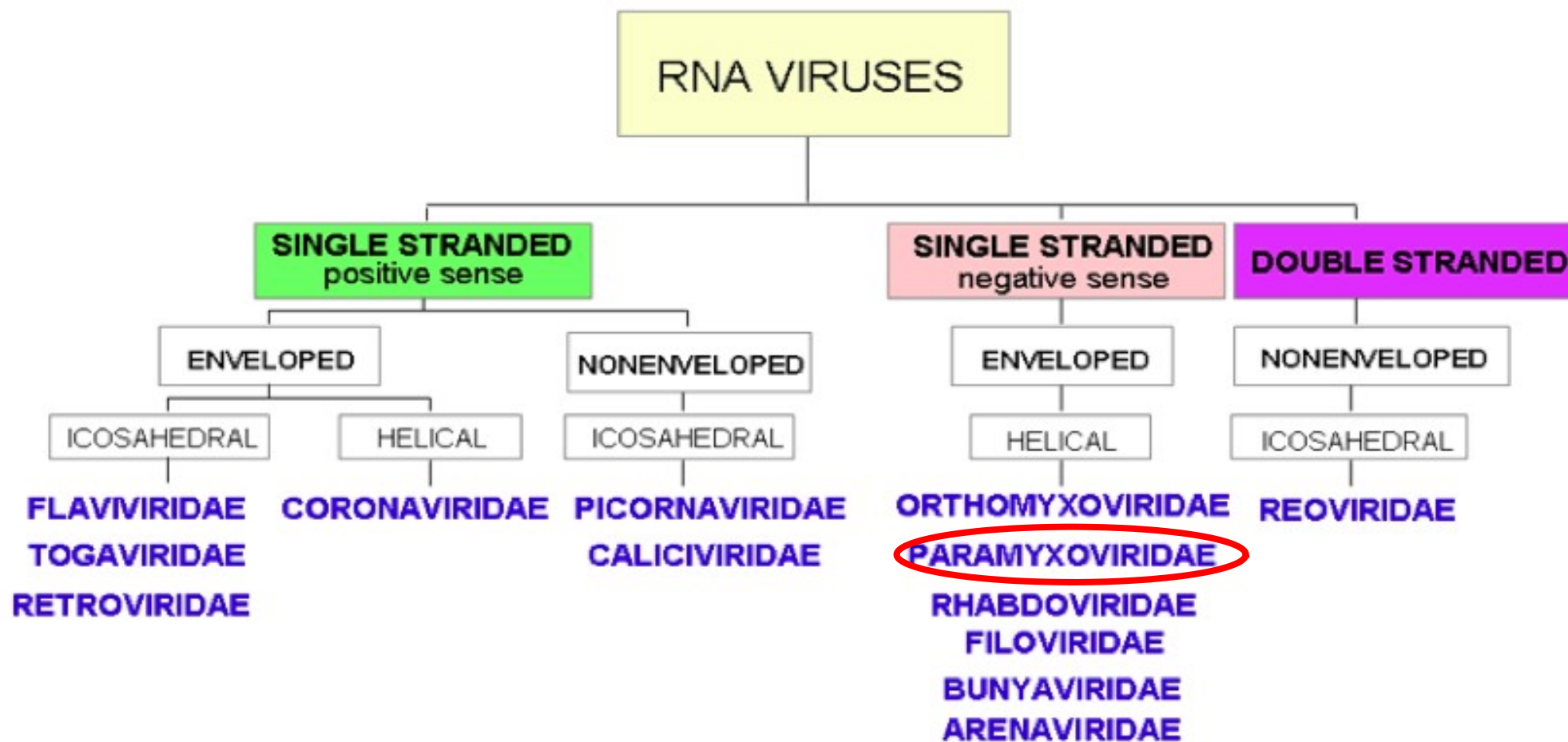
Whooping Cough

## Lower Respiratory Tract Diseases

### **Bronchitis** **Bronchiolitis** **Pneumonia**

Pulmonary TB

Lung Abscess



# LARYNGITIS

## 2-Croup



### Definition

Inflammation of vocal cords of the larynx

### Etiology

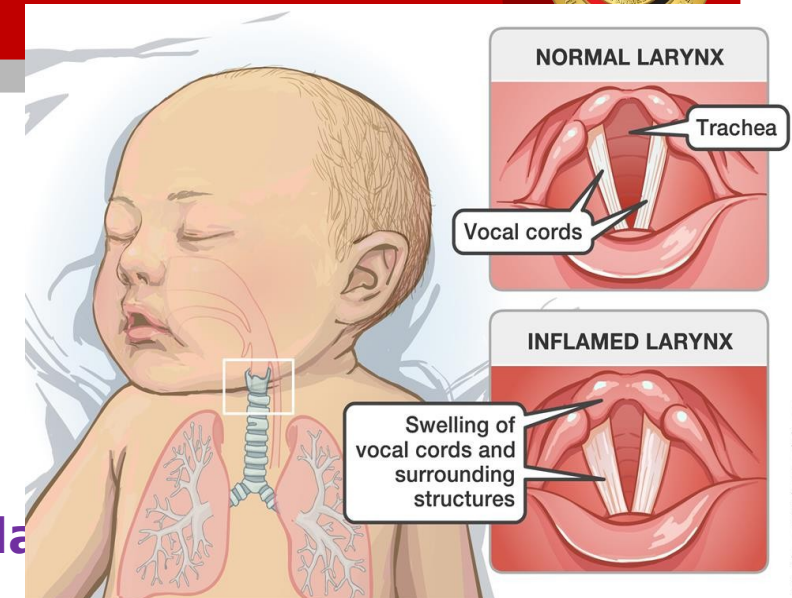
1- Parainfluenza virus & Rhinoviruses ( commonest causes of laryngitis)

2-Influenza & corona viruses

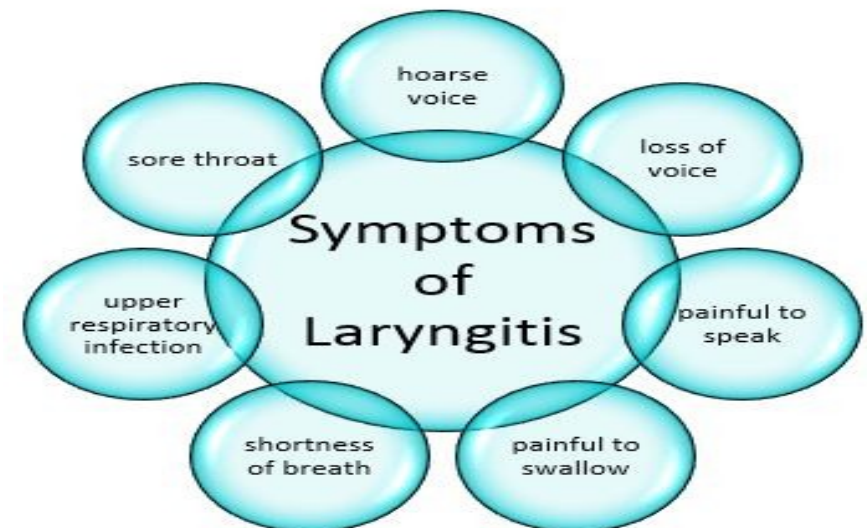
### Clinical picture

■ Hoarseness of voice

■ Aphonia (inability to speak)



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# CROUP



## Definition

Inflammation of larynx ,trachea & large bronchi (larngotrach

## Etiology

**1- Parainfluenza virus (especially type 1): commonest ca**

**2- Respiratory syncytial virus (RSV)**

## Clinical manifestations

**1-Inspiratory stridor** (harsh noise on breathing due to c  
**especially in children**

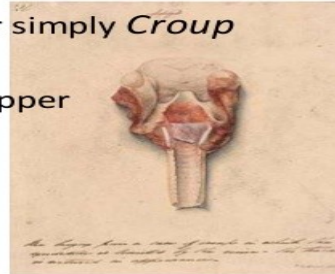
**2-Hoarseness of voice**

## Croup

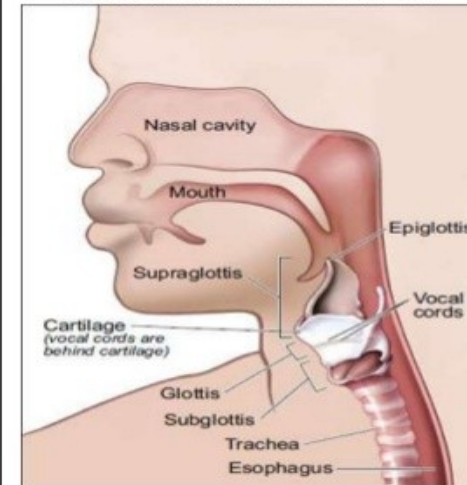
Derived from the old Anglo-Saxon verb croup meaning "to cry hoarsely".

*Laryngotracheobronchitis or simply Croup*

The most common form of acute upper respiratory obstruction.

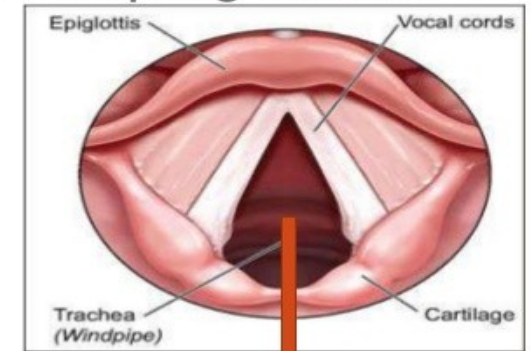


## Mechanism of developing stridor



Stridor can occur at the following places:

1. **Nose & Mouth**
2. **Larynx** (Epiglottis, Supraglottis, Glottis, Subglottis)
3. **Trachea.**



•An infant or child's airway lumen is naturally narrower/smaller than adults.  
•Therefore, any minor reductions to this airway diameter (such as inflammation, mucosal edema, foreign object, collapsing epiglottis) can result in further narrowing or obstruction of the airway.  
•Due to this narrowing, it causes an exponential increase in airway resistance which makes it significantly difficult for the child to breathe.



# Human parainfluenza viruses (HPIVs)



## Structure

**A - Family :** paramyxoviruses

## B-Nucleocapsid

■ **ss RNA**

• Helical

**C- Enveloped with 2 surface glycoproteins**

**1-Bifunctional protein : Haemagglutinin-neuraminidase (H,**

**attaching** the virus  
to host-cell

receptors(early)

**2-Fusion (F) protein (see RSV)**

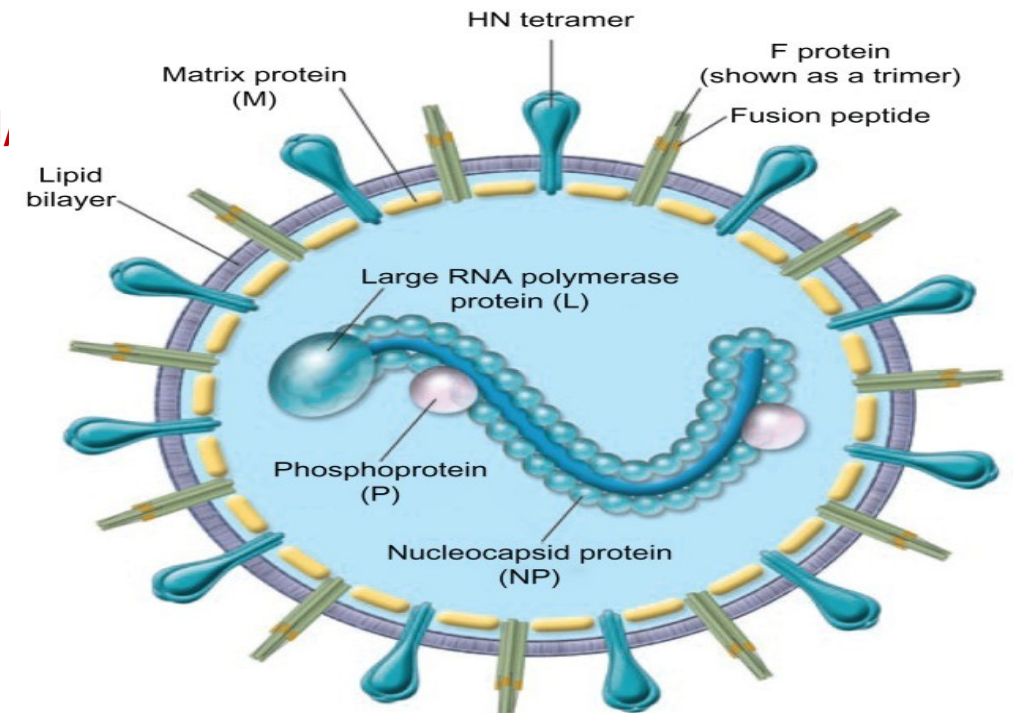
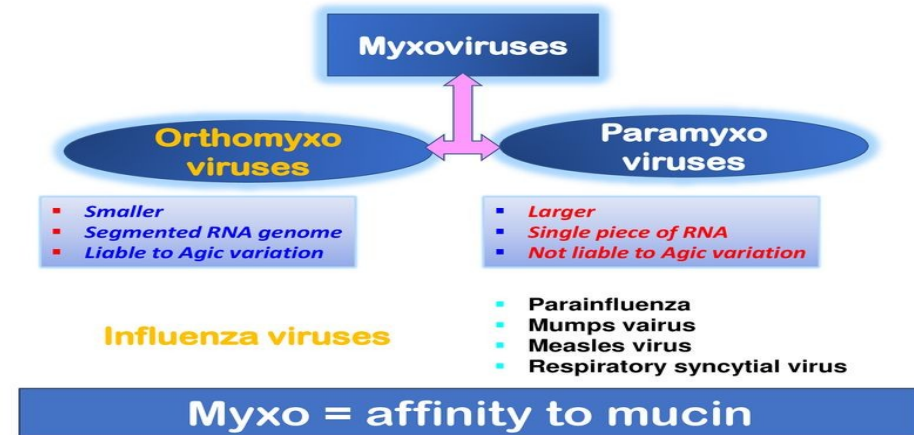
**releasing** new  
virions from  
infected cells(late).

## C-Classification

**4 serotypes :** HPIV 1, 2, 3, 4

9/11/24

infectious module





# Human parainfluenza viruses (HPIVs)



## Pathogenesis & Clinical manifestations

**A-The infection is localized to RT (no viremia).**

in both adults & young children

The virus attaches to host cells by **haemagglutinin**



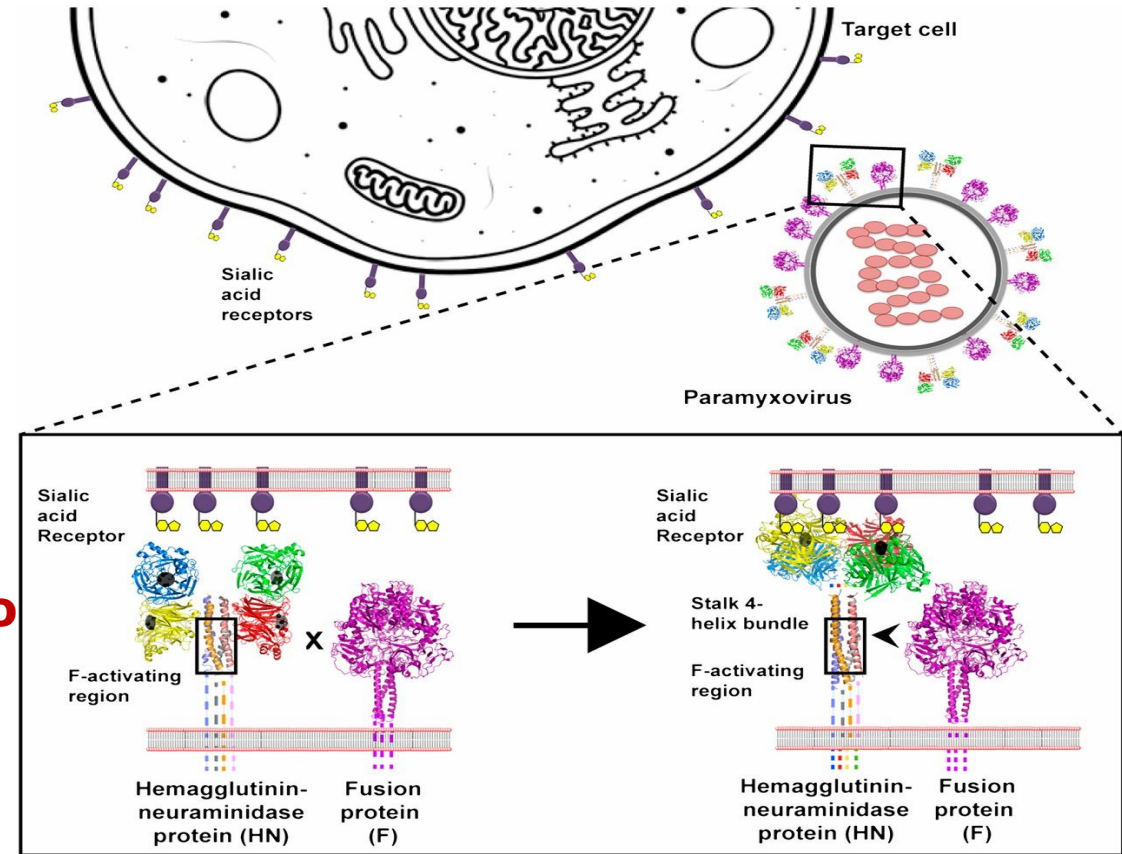
Envelope fuses with the host cell membrane by **F pro**

## B-In adults

- Virus multiplication & Inflammation **are limited**

to **upper RT**

**Disease : Common cold.**



# Human parainfluenza viruses (HPIVs)



## C - In young children < 5 years

- Airways are small & immunity is immature



Bronchi, bronchioles and lungs are involved

- Vocal cords of the larynx become swollen



Obstruction to the inflow of air



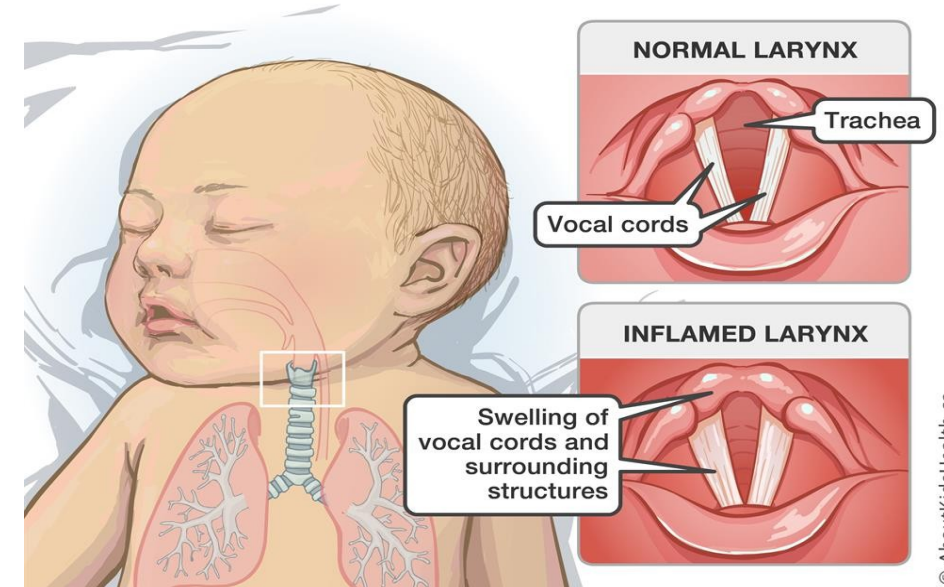
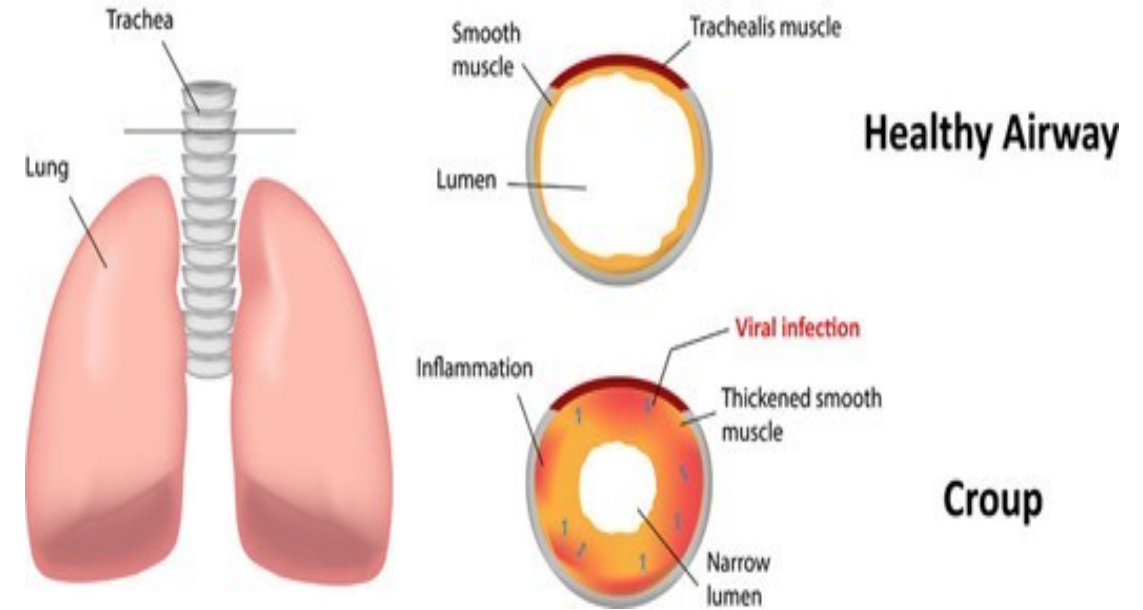
**Inspiratory stridor**

## ■ Diseases

1-Croup (acute laryngotracheobronchitis)

2-Laryngitis, bronchiolitis and pneumonia.

infectious module



# Human parainfluenza viruses (HPIVs)



## Laboratory diagnosis

**Specimen:** nasopharyngeal aspirate.

### A-Direct demonstration

**1-Detection of Ag** : by DIF

**2-Detection of viral RNA** : by PCR

### B-Serology :

Detection of **IgM** OR **rising titer of IgG**

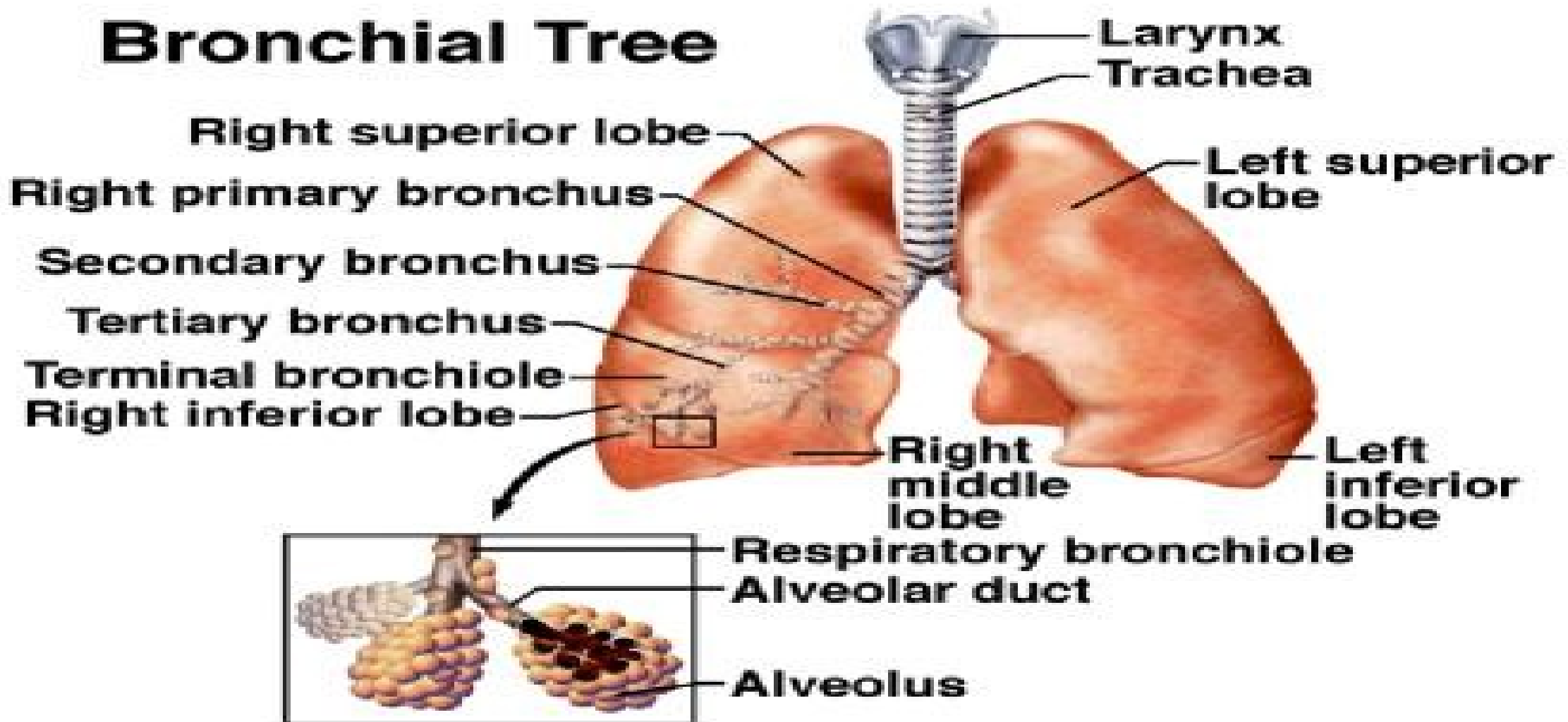
## Parainfluenza Virus Laboratory Diagnosis

- Detection of Antigen - a rapid diagnosis can be made by the detection of parainfluenza antigen from nasopharyngeal aspirates and throat washings.
- Virus Isolation - virus may be readily isolated from nasopharyngeal aspirates and throat swabs.
- Serology - a retrospective diagnosis may be

# Lower Respiratory Tract Infections



## Bronchial Tree



# Respiratory Tract Infections

## Upper respiratory tract Diseases

### **Common Cold** **Pharyngitis**

Otitis Media

Sinusitis

### **Laryngitis**

Epiglottitis

## Upper and Lower respiratory Tract Diseases

### **Croup**

### **Influenza**

Whooping Cough

## Lower Respiratory Tract Diseases

### **Bronchitis** **Bronchiolitis** **Pneumonia**

Pulmonary TB

Lung Abscess



# 1-BRONCHITIS



## Definition

**Self limited** inflammation of bronchi

## Etiology of acute bronchitis

**Viruses : Most common 1ry pathogens**

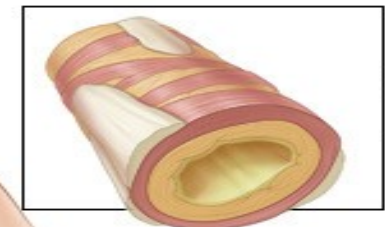
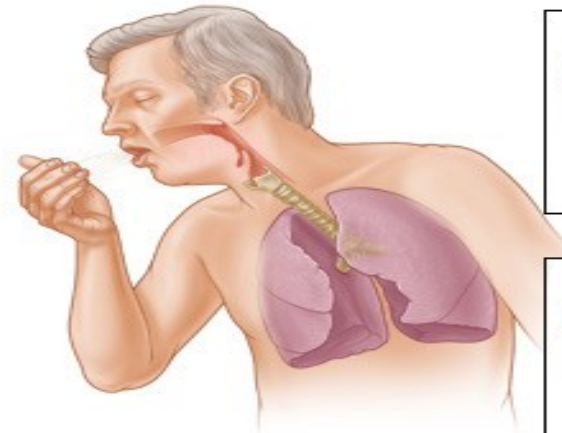
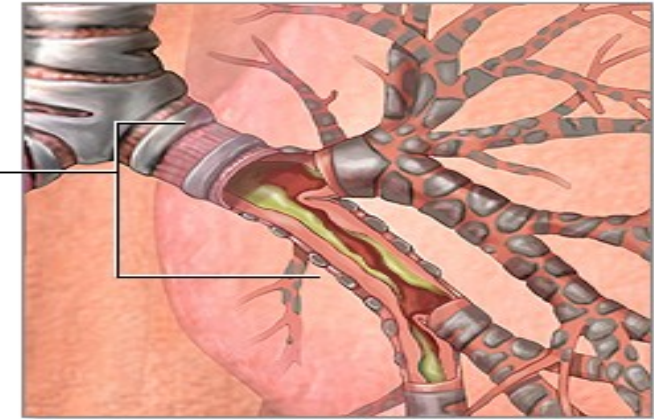
1-Influenza viruses

2-Parainfluenza viruses ,

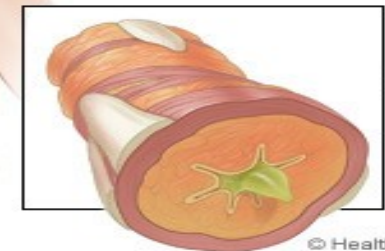
3-Respiratory syncytial virus



Inflamed  
primary and  
secondary  
bronchi



Normal  
bronchial  
tube



Inflamed  
bronchial  
tube

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# 1- BRONCHITIS



## Pathogenesis

★ Viral infection → inflammatory response

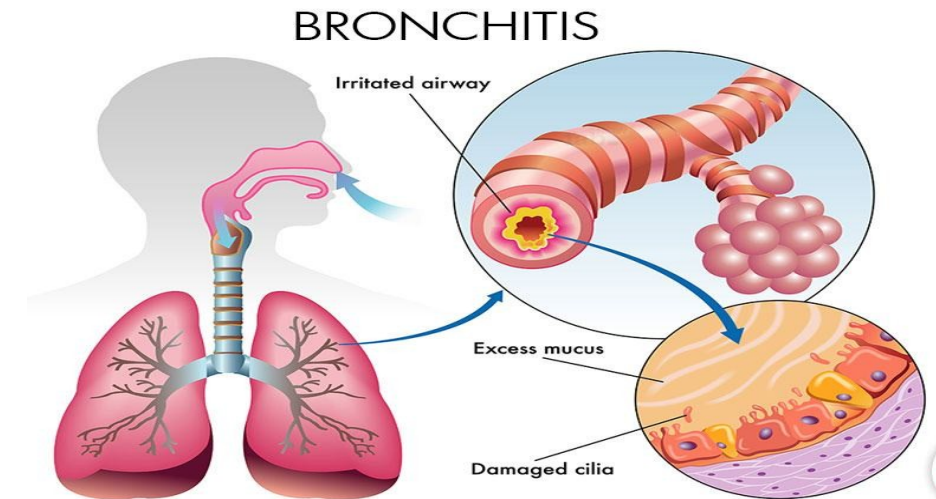
→ ↑ mucus production

→ **coughing** ( to clear mucus).

## ★ Clinical Manifestations

**1-URTIs symptoms** : Nasal congestion, sore throat

**2-Cough , with or without sputum**



## The Symptoms of **BRONCHITIS**



- Cough
- Production of mucus (sputum), which can be clear, white, yellowish-gray or green in color
- Fatigue
- Shortness of breath
- Slight fever and chills
- Chest discomfort

# 2-BRONCHIOLITIS



## Definition

Inflammation of the bronchioles ;  
the small airways **less than 2 mm in diameter**

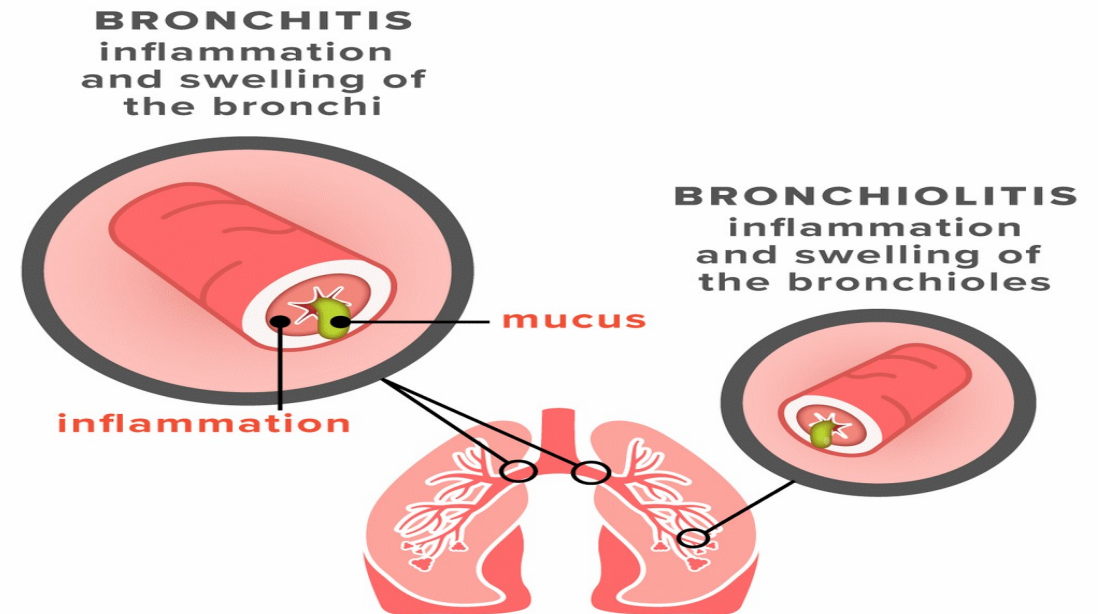
## Etiology

**Viruses are the only pathogens in child**

**1-Respiratory syncytial virus (main cause)**

**2-Human metapneumovirus (2<sup>nd</sup> common)**

**3- Parainfluenza virus**



Bronchiolitis is caused by a viral infection and is seasonal ,peaking in the winter months.

The most common cause is respiratory syncytial virus (RSV) which accounts for 80% of cases

# 2-BRONCHIOLITIS



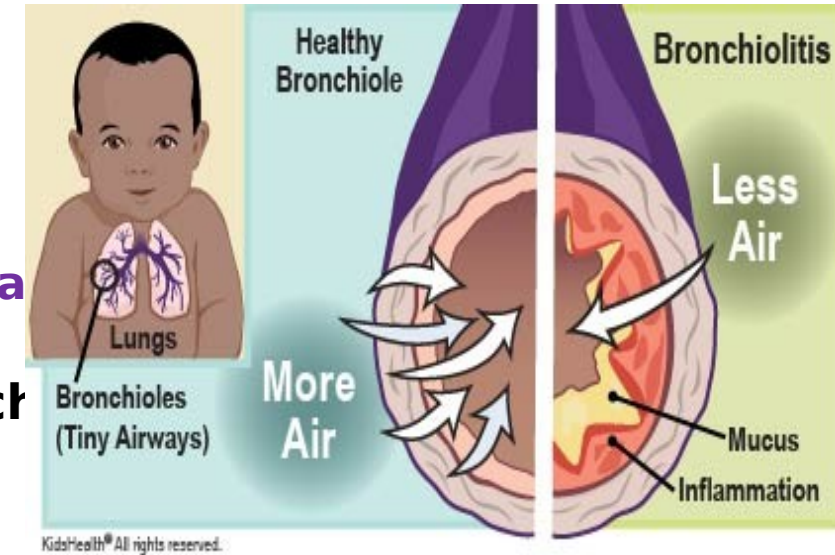
Pathogenesis

Age affected

Particularly among children under 2 years of age as bronchioles ha

Viruses **directly** damage the epithelial cells of the **terminal bronch**

Inflammation and obstruction of the **small airways**.

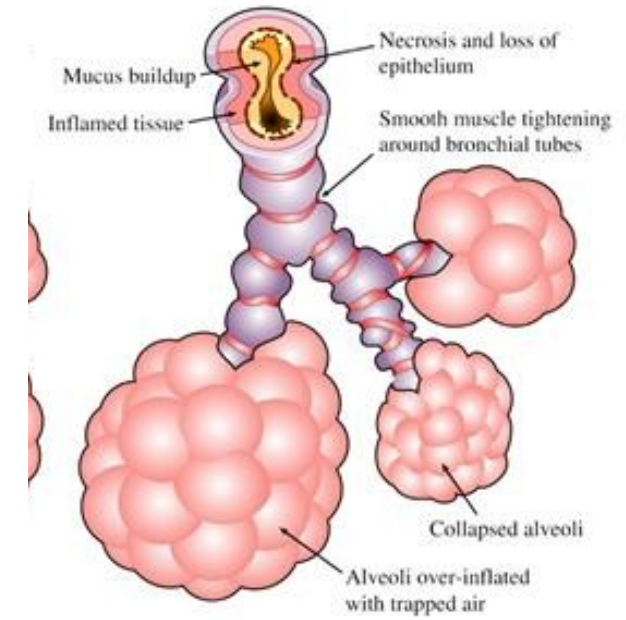


Clinical Manifestations

Respiratory distress

➤ **Cough, cyanosis**

➤ **Dyspnea**





# Respiratory syncytial virus (RSV)



## Structure

**A - Family :** paramyxoviruses

## B-Nucleocapsid

■ **ss RNA**

• Helical

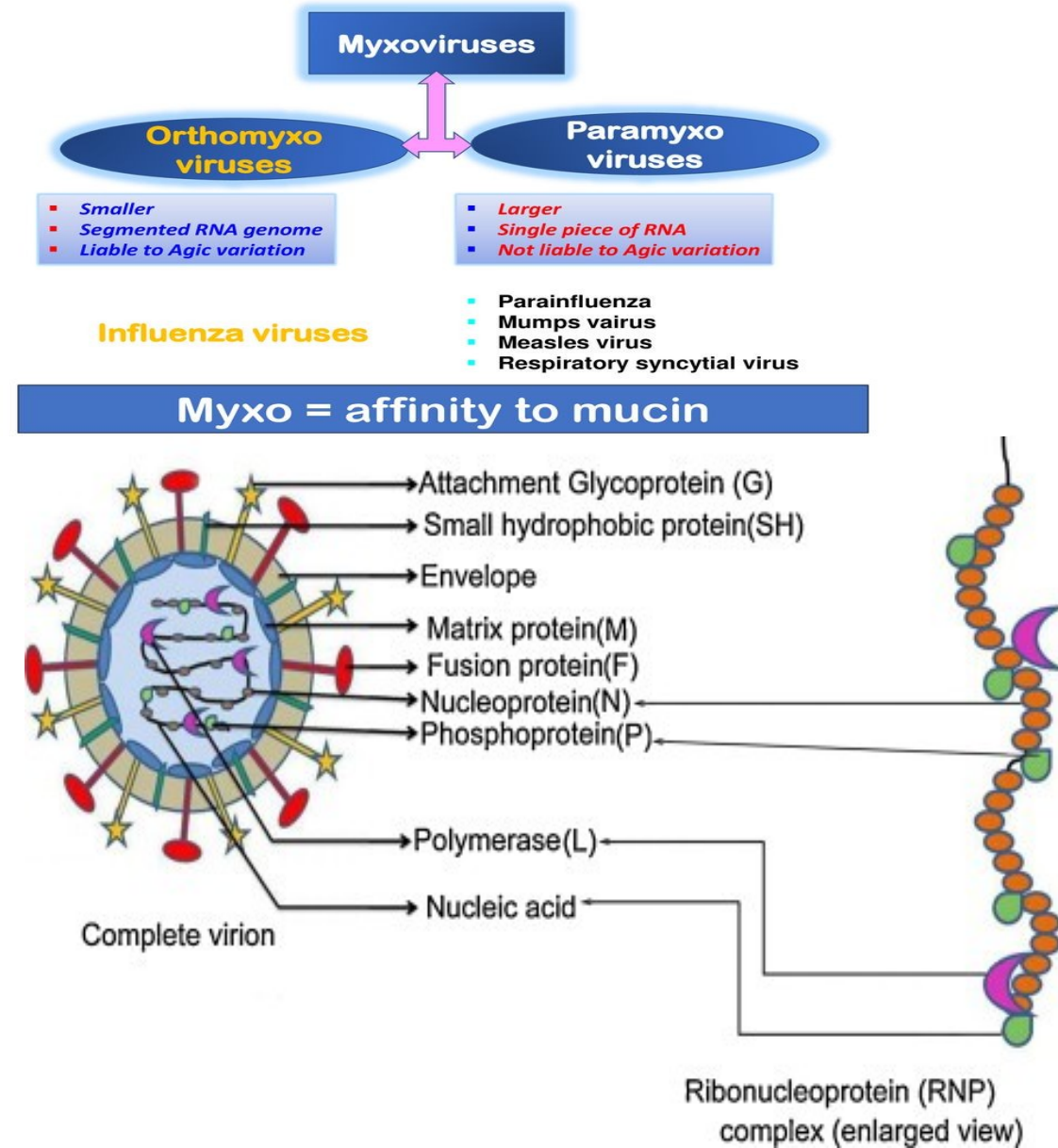
C- Enveloped ,with 2 surface glycoproteins (No H/N)

**1-G protein**



**Attachment** to host cells

**2-Fusion (F) protein**



# Respiratory syncytial virus (RSV)



## Pathogenesis

### A-Mode of transmission

#### 1-Droplet

**2-Direct contact** of contaminated hands with nose or mouth  
RSV causes outbreaks of respiratory infections especially in young children

### B-Viral replication

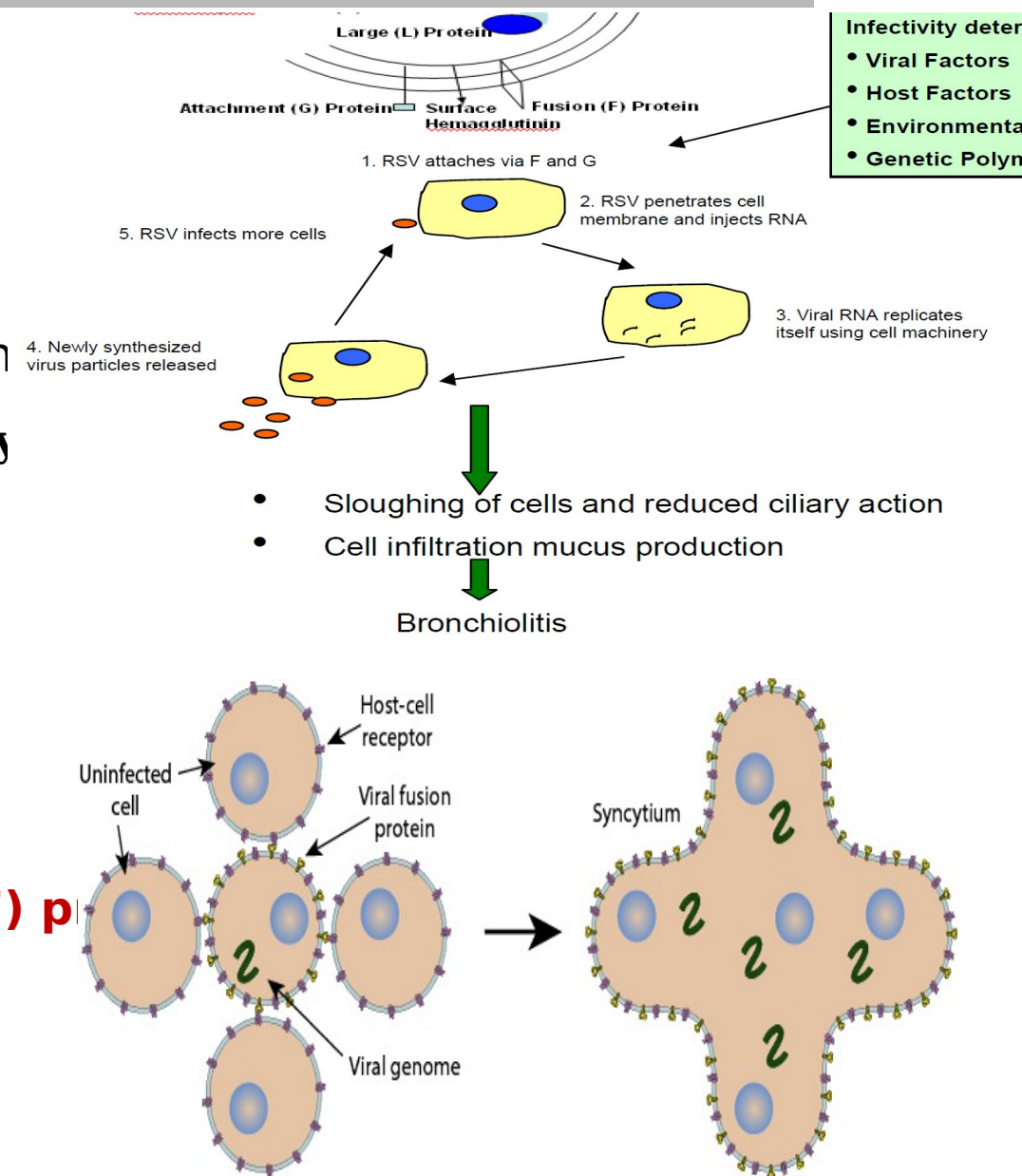
**A-The infection is localized to RT (no viremia).**

**B-The virus attaches to host cells by G protein**

Envelope fuses with the host cell membrane by **fusion (F) protein**

F protein causes cells to fuse

Formation of **multinucleated giant cells (syncytia)**



# C-Immunity

## 1-Repeated infections are common,Why?

**a-Incomplete (short lived) immunity :**

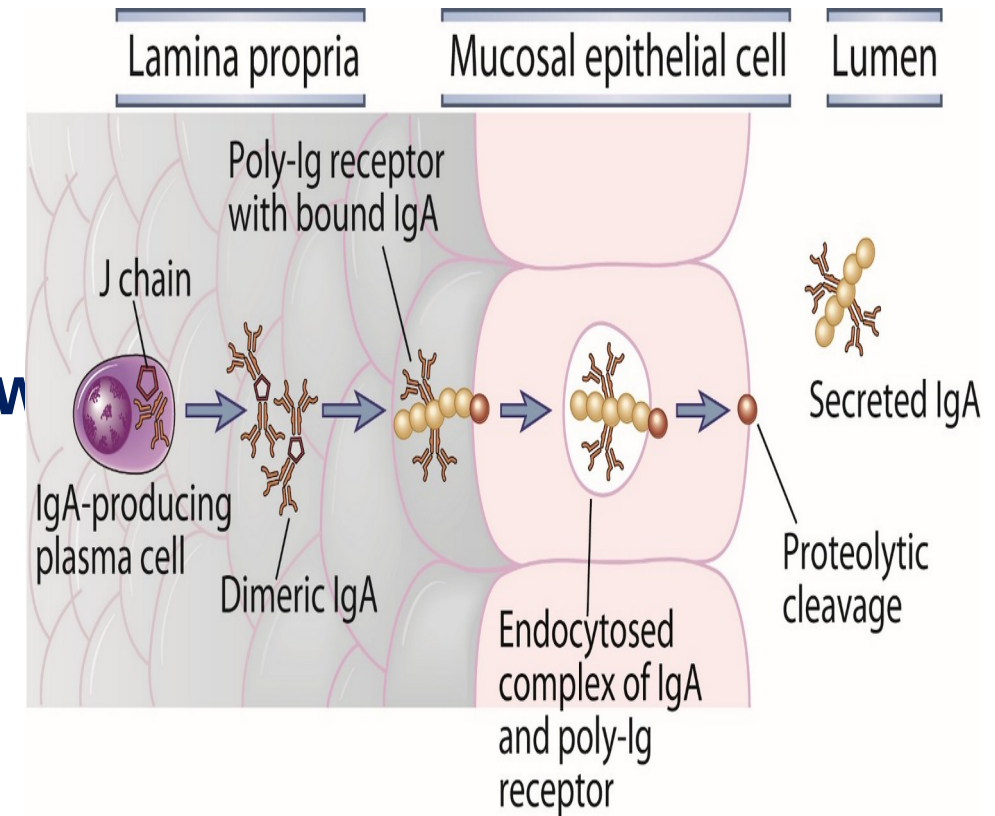
as it is mainly due to **IFN $\alpha$  & secretory IgA**

**b -Antigenic drift** : variation in surface proteins

## 2-Frequency & severity of infection ↓ with aging , W

**a-↑ Secretory IgA**

**b- Larger air passages**





# Respiratory syncytial virus (RSV)



## Clinical manifestations

### A- Infants (< 2 yrs)

**Bronchiolitis & pneumonia (commonest cause)**

### B- Adults

Common cold & bronchitis

C - Elderly, adults with heart or lung diseases & immunocompromised patients

**Pneumonia.**



## Laboratory diagnosis

**Specimen** : nasopharyngeal aspirate

### A-Direct virus demonstration :

a. Rapid Ag test : by **DIF** (commonly used)

b. Detection of viral nucleic acid : by **PCR**

### B-Isolation

CPE : **syncytia** formation

### C-Serology :

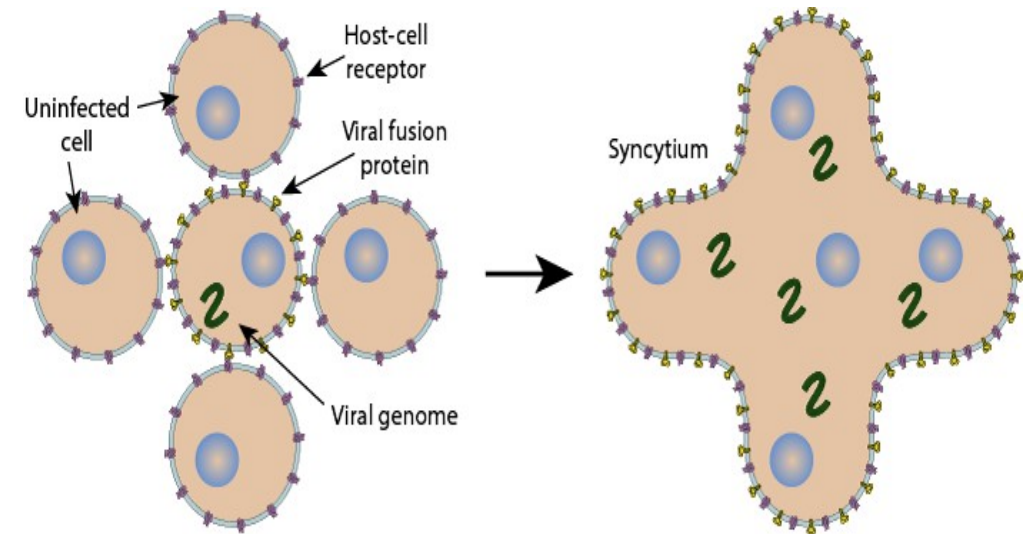
Detection of **rising titer of IgG**

## Prevention

**Monoclonal antibody against the RSV F (fusion) protein :**

**For premature infants and children with congenital heart**

**NB** Can be used also to **treat immunocompromized patients**



### Palivizumab (Synagis®): Mechanism of Action

- Palivizumab is a monoclonal antibody that binds the F (fusion) protein of RSV
- Palivizumab prevents infection of the host cell
- Palivizumab reduces viral replication and spread of RSV to other susceptible cells
- **Protective levels need to be achieved prior to exposure to RSV**



# Lecture Quiz



**Which virus is the leading cause of the croup syndrome in young children?**

- a) Influenza virus
- b) Respiratory syncytial virus
- c) Parainfluenza virus
- d) Adenovirus
- e) Rhinovirus

# SUGGESTED TEXTBOOKS



- ***Review of Medical Microbiology and Immunology,  
Warren Levinson***
  - from page 683 - 697
  - from page 704 - 707
  - from page 1359 - 1360
  - from page 1363 - 1373





Thank You